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# VENTILATION

A GREAT PREVENTIVE OF CONSUMPTION AND CHOLERA.

## VENTILATION,

*The art of passing currents of fresh pure air through crowded rooms, in order to keep the atmosphere in a fit condition for healthy respiration.*

Free Atmospheric Air consists (see the researches of Mr. F. Brunde) of two ingredients, Oxygen and Azote.[*] These are blended together in the proportions of one atom of the former to four of the latter. When these proportions are altered, the air becomes unfit for respiration. But in breathing, we exhaust from atmospheric air the oxygen, which is its vital constituent; so that, at each repeated exhalation of the same air, it becomes less and less capable of sustaining animal life. In like manner, of combustion, by which the oxygen of as much atmospheric air as enters into the ignition, is exhausted. But besides that inhalation thus exhausts the air of its vital principle, exhalation vitiates it; in the act of respiration, a certain portion of the oxygen drawn into the lungs is converted into carbonic acid gas, and expelled from them. Now, the gass thus evolved around us is a narcotic poison, fatal to breathe in any considerable quantity. And hence the air of confined rooms is soon rendered, by breathing, not merely incapable of supporting life, but absolutely poisonous.

The positive, as well as negative effects of breathing unrenewed air, can hardly be better illustrated than by the well-known case described by Howard in his work on Lazzarettos, of the imprisonment of one hundred and forty-six captives in the black hole at Calcutta. It was a dungeon entirely unventilated. When these prisoners had remained there ten

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[*] The presence of a very small quantity of Carbonic Acid Gas, less than one per cent., is also detected in free atmospheric air.

hours, but twenty-six were found alive, and most of these suffered afterwards with malignant fevers. The others must have been suffocated, but these were poisoned.

It is by the like, but rapider evolution of carbonic acid gas from burning charcol, that death by asphyxia is produced in a small, close room. This is, from its certainty and its freedom from pain, the favorite resort of all such Parisian lovers, or voluptiaries, or gamblers, or criminals, as find life a burden: See *Annules de la Suicide.* It is from impure air that so many thousands have lost their lives in coal mines and even in wells.

These principles and facts sufficiently explain how it is that he who sits, day after day, in these crowded halls, the House of Representatives, the Senate Chamber, or the Supreme Court room, gradually finds that he can no longer bring to his high duties his accustomed powers, that he begins soon to perceive that exhaustion, mental, as well as bodily, overtakes him more quickly than it was wont; and that, by and by, ensue loss of appetite, confirmed dyspepsia, and such a general disorder of the system and decay of the functions, as often end in chronic disease and even death.

### *Quantity of fresh air necessary to healthy respiration.*

As the main phenomena of the progress of respiration, it will be sufficient, from amongst the many writers on that part of physiology, to refer to Combe and Peclet. The researches of Anatomy and Chemistry have shown that the air-vessels of the adult lungs present, when inflated, a surface of about fifteen square feet, and that an adult respires, at each breath, about forty cubic inches of air. Fresh air loses, by inspiration, eight per cent. of its oxygen. This is replaced by as much carbonic acid gas. The vapor (aeriform moisture) discharged by the lungs of an adult has been ascertained to amount to six grains per minute—that is to say, to one and a half pounds troy, for every twenty-four hours. This last, however, is but a part of the insensible perspiration, a process ever in action and indispensable to that of life. By this process, the air is yet further vitiated around us; the effluvia and vapor of animal matter exuded from the surface of each human body, is estimated at from nine to twenty six grains per minute. Lavoisier and Seguin, after tedious experiments, came to the conclusion that the insensible perspiration, from the skin and lungs together, amounted, in the twenty-four hours, to five pounds; and that, of this, the cutaneous exhalations constituted two-thirds. They who desire other illustrations of this part of the matter, may find some curious examples in the narratives of the voyages of Franklin, of Ross, and of Captain Wilkes.

That respiration becomes oppressive in crowded rooms, all know. According to the careful experiments of Seguin, above three and a half cubic feet of air per minute are, in a temperature of sixty degrees, charged with animal vapor, transmitted through the skin of an adult, and rendered unfit for respiration. Add to the ordinary rate of the exhaustion or vitiation of the respirability of the air, the further consumption of oxygen which ensues when in a thronged room, it becomes necessary to employ artificial light, and it may at once be seen that a large additional supply of air is requisite. A single candle, or any thing producing an equivalent light, is known to consume as much oxygen as do the lungs of one grown person. For this, I may refer to Count Rumford and Dr. Arnot.

### *Ill Effects of non-ventilation.*

Not more absolutely does the stomach require, at due intervals, a regular supply of food, than do the lungs need, all the while, a free supply of oxygen. Both are equally necessary to the performance of the vital functions; without the due provision of both, health cannot be preserved nor life maintained. But as some stomachs can much longer than others sustain the privation of food, so the lungs of particular individuals are more capable than those of others of continuing to inhale a deteriorated atmosphere. Dr. Ure says that the great principle of ventilation is, never to present the same portion of air to the lungs twice over, for that to do so predisposes the system to disease; and that no one is free from danger after having sat for hours inhaling the breath and effluvia of unventilated apartments. From the registers of an extensive hospital in Dublin, it appears that, by means of a thorough ventilation alone, the proportion of deaths, among patients of the same description, was at once reduced from one in six to one in twenty. So, too, it is agreed among all medical writers, that the higher rate, among women than among men, of death by pulmonary consumption (Phthysis) must be ascribed to the more in-door life prevalent among the women. The difference has been found in Massachusetts, by a register kept there in 1845–46, to amount to 63 per cent. in favor of the male sex. (See, for this fact, Dr. Jarvis's Physiology.) Thus, too, it is remarked that young men of severe habits of application often contract at College, from close confinement to their ill-ventilated rooms, maladies of which they never recover. Even in the less delicate organization of the inferior animals, the same physiological laws are found to operate. Take, for an instance, the following perfectly authenticated case not long since occurring among the monkeys of the Zoological Garden, London. A new habitation for Jacko had been built, a sort of winter palace, closed everywhere with glass and warmed by furnaces. Into this well-imagined structure, sixty healthy monkeys that had spent several winters in the garden were put. At the end of four weeks, ten of the sixty were left alive. The cause of the mortality was at once surmised, and ventilation of the building resorted to. The surviving ten recovered and became perfectly healthy. Yet again; a celebrated veterinary surgeon, Mr. Youtall, speaking of consumption among the cattle, says that in several of the extensive dairy establishments near London, at certain seasons of the year, the cows were attacked by disease and died: all that medicine could do was ineffectual, until it was perceived that the buildings wanted ventilation. A thorough system of this was adopted; disease and death ceased; the cattle became healthy. To return, however, to the human subject: Dr. Griscom, of New York, in his report on the intermittents of 1842, says that the first among the serious causes of the general ill health then reigning was the crowded condition of the dwellings in many quarters of the city, and their insufficient ventilation. There are few who have travelled by night in our canal boats that have not remarked the extremely impure state of atmosphere when morning arrives—especially if it be at the seasons when the doors and windows have to be kept close. Most persons have observed what pernicious effluvia hung about the sick room. Even ball rooms are often felt to breathe, in the midst of revel, airs almost equally insalubrious. The House of Representatives, the Senate Chamber, and, above all, the Supreme Court, after long sittings, present strongly the same phenomena. On board of emigrant ships, when ship-fever had broken out, it has stopped as soon as a thorough method of ventilation has been employed. All physicians and men of science agree that cleanliness and ventilation are a preventive of that terrible human scourge, the Cholera, of intermittent, of typhus, and of other fevers. Messrs. Russel and Barry, who were sent over the continent of Europe, and to a part of Asia, by the British Government, for the purpose of collecting information in regard to the treatment of spasmodic cholera, state that, from careful observation, they were able to aver that, under proper circumstances of cleanliness and ventilation, this scourge seldom spread in a family. This is not ill illustrated by an instance in our own country: in Philadelphia, the cholera of 1832 broke out at the Arch street prison; nearly one hundred persons were attacked on Sunday morning, and before night about seventy of them had died. The prisoners were removed, and few, if any of them, died afterwards. The building was one of the worst ventilated in the whole country, and was afterwards very properly pulled down. Paris affords a still wider example of the same truths. It has been found that in no town of Europe, population considered, was the cholera so fatal as in that city, in 1832. For the reason see the treatise *Du Cholera, par M.*

*Bureaud, Rio frey*, D. M. p. 43. It would seem, at first sight, says he, that there could be little fear of epidemics in our good city. In Paris we gaze on the splendors of architecture; we are surrounded by the fairest works of art, and everything would seem to exclude the idea of insalubrity; yet, in spite of all this brilliancy of exterior, Paris is perhaps one of the most unhealthy capitals in the world, through its want of cleanliness and ventilation in its buildings and dwellings. Once more, let us see, in the *Medico-Chirurgical Review* for 1848, the Report of A. Thom, Esq., on the spasmodic cholera in India, amongst Her Majesty's eighty-sixth regiment, posted at Kurruchee, in 1846. It says that the first discoverable cause of such mortality from cholera in this regiment was the deficiency of accommodations and the unventilated state of the apartments. Amongst the sixtieth Rifles, consisting of nine hundred and eighty men, one hundred and eighteen were attacked, and seventy-five died. Of two hundred officers, living chiefly in detached and partially ventilated buildings, but nine were attacked and three died. Of course, had the soldiers living in barracks occupied detached houses, the per centage of deaths among them would not have exceeded that among the officers.

Hundreds of cases might be cited, proving the danger of sitting or living in an unventilated room. For health, it is just as necessary to have fresh air in one's apartment on Christmas day as in the warmest weather of midsummer. Persons from the country constantly cry out against rooms warmed by grates and stoves; they are habituated to the comforts of sitting before a good wood fire; and this, indeed, does afford, beyond all doubt, the most wholesome heat, while it at the same time accomplishes a partial ventilation, by means of the great amount of air that must pass through the room, in order to support the combustion.

Many persons are led to the conclusion, that in order to free a room of its foul air, it is sufficient to make an opening in the ceiling; for that the vitiated air, being heated, will ascend. From many experiments, I have found that a mere opening will accomplish but little; its effects being dependant on the relative and constantly varying condition of the air within and without. If that without be the colder, then there will be a rush of air inwards, and this will modify the interior atmosphere somewhat; but the evil will still exist, in a great degree, unremoved, unless complete means be put in use. The only such that are effectual in large crowded rooms, are to place heated surfaces above the ceiling, and to draw to these, for combustion and rarefaction, the air which lodges and is detained under the seats, floors, projections, galleries, ceiling, and all other parts of the house. My plan of ventilating such places is as simple as that now used in coal-mines; and is, I believe, entirely my own. It accomplishes what several writers on the subject had suggested as necessary: Reid, for instance, had said, that the ventilation of apartments is closely connected with their warming, and that the great difficulty to be overcome is to provide for both objects at the same time. So, too, J. Sylvester had intimated, that if the air above the ceiling be, by artificial means, raised to a higher temperature, it will extract the vitiated air from rooms. W. F. Brunde had also, in his remarks, stated it as essential that the air should be taken off at both the floor and ceiling at the same time. That portion of the process for thus drawing off the air from the floor of the Senate Chamber has answered all the purposes intended. I had tried many an experiment and method before arriving at it.

In 1841, the Commissioner of Public Buildings was authorized by the Committee on Public Buildings of the House of Representatives, to procure plans for ventilating the hall of that body. Upon being applied to by that officer, I examined the building and prepared my plans. These, when, along with those of many others, they were submitted, were adopted by the Committee—some of them, however, still doubting whether a hall so large could be warmed and ventilated. They therefore determined first to make trial of the warming part of the plan, and if that succeeded, to finish the work upon the same system. An appropriation was made; the lower story of the building was completed; the hall and passage were warmed by heated air, instead of hot water.

To finish the system thus in part applied, all that is now wanted is the construction of flues for drawing off the carbonic acid gas from along the surface of the floor, from under the lounges and other seats, and from the floor of the galleries; as also flues from the ceilings of the ladies' and gentlemen's galleries to those other flues which lead to furnaces in fire-proof rooms along the ceiling. When the furnaces are set in operation they exhaust the carbonic acid gas from the floor, and the vitiated air from the ceiling, for combustion and rarefaction. By continually exhausting from all parts of the hall so large an amount of air, a vacuum is created, and this is immediately filled with fresh pure warm air in winter, and with cool air in summer.

The Chairman of the Committee having requested me to collect the views of different writers on the evil consequences of non-ventilation, and also obtain the opinions of scientific men, of architects, and of medical gentlemen, as to the plan prepared by me and adopted by the Committee, I have accordingly, in what is thus far presented, condensed what can be found in the best writers; and I place herewith such opinions of men of science as to my process as I was directed to obtain. To such as have or feel an interest in the ventilation of our Capitol, they are all herewith submitted, by

Your very humble servant,

JOHN SKIRVING.

# CERTIFICATES.

Sir: I have examined the plan by which Mr. Skirving proposes to ventilate the Hall of Representatives, and find that it is the same, essentially, as that adopted for the warming of the new Parliament Houses in England, under the direction of Sir David Reed, and which has also been introduced into several other public buildings in Europe with entire success.

I see no reason why this same principle should not be equally applicable to the Hall of Representatives. The necessity of free ventilation and the constant introduction of pure air into the Hall, in order to maintain the vigor of the body and the energetic action of the mind, is too obvious to need any remark. I have long been of the opinion that the bad condision of the atmosphere of the Hall, loaded, as it must be, after a few hours of the session, with carbonic acid gas and animal effluvia, has been a prolific source of disease among the members, and tends to render disease, when it does occur, severe and fatal.

Very truly and respectfully,
Your obedient humble servant,
THOMAS SEWALL, *M. D.*

Washington, *January* 30, 1845.

I consider it very important to the health of those frequenting the Hall of Representatives, that it should be properly ventilated. I have examined the plan proposed by Mr. Skirving, and think it well calculated to effect this desirable object.

JOHN FREDERICK MAY, *M. D.*

I fully concur in the opinions of Doctors Sewall and May; and will add, that many of the instances of sudden illness and death in crowded assemblages, are fairly attributable to the depraved condition of the atmosphere.

J. C. HALL, *M. D.*

WASHINGTON, *January* 30, 1845.

There can be no doubt of the absolute necessity of free ventilation to the enjoyment of perfect health; and every medical man sees, almost daily, the bad effects resulting from the neglect of this most important principle.

HARVEY LINDSLY, *M. D.*

WASHINGTON, *January* 31, 1845.

I entirely concur in the above opinions of the necessity of pure air for health, and hope Mr. Skirving will succeed in effecting so desirable an object as to ventilate the Senate Chamber.

THOMAS MILLER, *M. D.*

WASHINGTON, D. C., *January* 30, 1845.

The proposition for ventilating the Senate Chamber, submitted to me by Mr. Skirving, of this city, is, in my opinion, well adapted to the purpose. That ventilation, in an apartment occupied by so many, is absolutely necessary for health of body and mind, is evident without argument. It is asserted by high authority that ten cubic feet of fresh air per minute for each individual is the smallest allowance that should be made, in order to insure healthful ventilation; and also, that in rooms for public assemblies, the best plan is to carry off the respired and vitiated air by the shaft of a furnace. To effect these objects, Mr. Skirving's proposed method would, I think, be fully competent.

WILLIAM H. VAN BUREN, *M. D.*
*Assistant Surgeon U. S. Army.*

I fully concur in the above.

H. L. HEISKELL, *M. D.*
*Surgeon U. S. Army.*

I also concur in the above opinions.

THOMAS LAWSON,
*Surgeon General.*

*The Committee appointed by the Franklin Institute, Phila.*

The undersigned, after examining the plans of Mr. John Skirving for ventilating the Hall of Representatives, Senate Chamber, and Supreme Court, are of the opinion that they are founded on correct principles. It is not only in accordance with the established law of nature, but has been repeatedly carried into operation in buildings in Europe with entire success. We have full confidence in the mechanical skill of Mr. Skirving to carry out his plans to the satisfaction of all parties.

Messrs. SMITH,
PATTERSON, } *Committee.*
*January* 10, 1842. PEALE,

I have examined the plans of Mr. J. Skirving for ventilating the Hall of Representatives and Capitol, and I fully concur with the opinion expressed by the Committee of the Franklin Institute. The plans are well devised, not only for efficiency, but likewise for avoiding every thing that would interfere with architectural beauty.

Very respectfully, your obedient servant,
T. P. JONES,
*January* 30, 1842. *Late Commissioner of Patents.*

*To the Hon. Chairman of the Committee on Public Buildings:*

Sir: The subscriber has examined the plan of warming and ventilating the Capitol, designed by Mr. John Skirving. The mode which he suggests for ventilating is upon the most approved modern principles, and in my opinion will effectually serve the purpose intended. A furnace placed in a fire-proof chamber, in the upper part of the building, will most certainly extract the deleterious air, by causing a rush towards the heated chamber; and its place will be supplied with a circulation of pure air; and it will have the effect of cooling the atmosphere in the summer season. I have examined Mr. Skirving's estimate for warming and ventilating, according to his plans as above stated, and think they are fair and reasonable.

With great respect, your obedient servant,
WM. STRICKLAND,
*Washington February* 4, 1845. *Architect.*

I have examiued Mr. Skirving's plan as above, and fully concur in the opinion of its merits as expressed above.

ROB'T. MILLS, *Architect.*

Sir: I have examined the plan submitted by Mr. Skirving for ventilating the Senate Chamber. It is a correct one in its principles, and will, in my opinion, not only be cheap but very effective. The plan which I submitted to the Regents of the Smithsonian Institution, for the ventilation of their building, is similar in every respect. The principles of ventilation are exceedingly simple, namely, the introduction of large bodies of pure air at the floor in such a manner as to prevent any perceptible current, and the drawing off at the ceiling and the floor. Mr. Skirving's plan, in my opinion, effects these objects perfectly.

Very respectfully, your obedient servant,

J. RENWICK, *Architect.*

Hon. R. M. T. Hunter.

I fully concur in the above.

ROB'T. MILLS, *Architect, &c.*

*To the Committee on Public Buildings:*

The undersigned has known Mr. J. Skirving for several years as a most ingenious and trustworthy mechanic. He is well acquainted with methods of ventilation in use both at home and abroad, in large buildings, and is capable of modifying existing plans to suit the particular cases which may be entrusted to him.

ALEX. D. BACHE.

*February 3d*, 1845.

Boston, *March* 20, 1848.

*To the Hon. R. C. Winthrop and other members of the*
*Massachusetts Delegation:*

Gentlemen: I have examined Mr. Skirving's proposed plan for ventilating the Hall of Representatives, and have heard his remarks. He appears to have given unusual attention to the subject. If his plan should be fully carried out in the Capitol, I have no doubt but the result will be satisfactory.

I have the honor to be, yours respectfully,

FREDERICK EMERSON.

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New York, *November* 19, 1848.

Dear Sir: I have examined the plan of Mr. J. Skirving for ventilating the Capitol, and I am satisfied that they are correct, and will answer the purpose fully.

I am, very respectfully, yours, &c.

J. L. MOTT.

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The plan of Ventilation I propose is, I believe, original with myself, so far as the mode of exhausting the air is concerned, which in my apparatus is done by rarefaction as well as combustion.

The ventilating apparatus of the Honse of Commons, London, cost £90,000. The air is drawn out by combustion; this requires large fires; the consumption of coal is about seventy to eighty bushels a day, and the expenses per session for warming and ventilating $15,000. See letter.

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House of Commons, *January* 2, 1848.

In answer to your inquiries, I am enabled to inform you that Dr. Reed's system does answer, so far as keeping the House of Parliament of a uniform temperature; but it is very expensive; the cost of coals, to keep up the heat in winter, and that of ice in summer, is very considerable. The expense is over £3,000. If your system is cheaper and more simple than Dr. Reed's, it would be a great recommendation. If you visit this country, I shall be glad to see you.

I am, sir, very respectfully,

J. BROTHERTON.

Mr. James Skirving,
*Washington city, United States of America.*

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The wam water apparatus which I purpose to use for the warmingof the House of Representatives will be simple, and cannot get out of order by neglect. And by this plan all smell of gas and dust will be avoided. To finish the Ventilation of the Hall of Representatives would cost $6,312.

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The following is a list of a few of the works and buildings I have been employed in, also the names of some of my employers:

Thames Tunnel, London,
Perkins' Steam Works, London,
Coleseum, London,
Royal Mint, London,
Marquis of Hertford's Gardens,
Ragley's Building, Grapery Pine Pits and Forcing Houses,
Birmingham—all kinds of furnaces for melting of metals and manufacturing purposes.
Machester and other parts of England.
Isaac Sergant, Paris, France.

*Philadelphia, Pennsylvania.*

Alms House,
Lunatic Asylum,
Deaf and Dumb Asylum,
Blind Asylum,
House of Refuge,
Exchange,
Musical Fund Hall,
Masonic Hall,
Moyamensing Prison,
U. S. Naval Asylum,
U. S. Arsenal,
U. S. Arsenal, Frankford,
Custom House,
Bank of United States,
And other Banks,
Seven Churches,
Girard Estate,
Gas Works,
Hon. Geo. M. Dallas,
Hon. Horace Binney,
Hon. J. R. Ingersoll,
Hon. John Sergant,
Charles Chauncey,
J. & P. Butler,
Richard Willing,
Judge J. K. Kane,
N. Biddle,
Thomas P. Cope,
Dr. Physic & Son,
Capt. Conner, U. S. N.
Charles McAllister,
Humphrey Atherton,
And nearly 5,000 persons in the State,
Lunatic Asylum, (Friends,) Frankford.

*New Jersey.*

Several yeasr superintendent for J. Bonaparte, Bordentow.
Com. Stockton,
J. Potter, Esq.
W. R. Thompson, Esq.
Rev. Bishop Doane,
Com. Stewart,
State House, Trenton,
And others in the State.

*Maryland.*

Lunatic Asylum, Baltimore,
State Buildings, Annapolis,
U. S. Naval School,
And others in the State.

### *Delaware.*

Wilmington Gas Works,
Mr. Dupont,
J. R. Latimer,
Pea Patch Fort,
And many persons in the State.

### *New York.*

Prime, Ward, & King,
Dr. Van Buren,
J. L. Mott,
Mr. Bloodgood, Albany.

### *South Carolina.*

Barhamville Institute,
Hon. J. R. Poinsett.

### *Virginia.*

Ex-President Tyler,
H. Dangerfield,
And a number of others in the State.

### *District of Columbia.*

Corcoran & Riggs,
B. O. Tayloe,
College, Georgetown,
Nunnery, Georgetown,
Mr. Bodisco, Georgetown,
Capt. Wilkes,
Gen. Jessup,
Hon. Senator Dix,
Hon. J. Q. Adams,
Navy Yard, and work of various kinds at the Public Buildings in this city.